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[Title of the Invention] Vehicle-installed Display Device and Portable Display Device

[*Claims*]

[Claim 1]

A vehicle-installed display device, comprising:

a vehicle motion detecting means configured to detect movements of the vehicle;

a display means configured to display an image;

a displayed image displacement computing means configured to compute a translational displacement of an image displayed by the display means using information that indicates a movement of the vehicle detected by the vehicle motion detecting means; and

a display control means configured to make the display means display images in such a manner as to cancel the translational displacement computed by the displayed image displacement computing means.

[Claim 2]

A vehicle-installed display device, comprising

a vehicle motion detecting means configured to detect movements of the vehicle;

a motion value determining means configured to determine a motion value related to a

movement of the head or an eye of a passenger by actually detecting the movement of the head or eye of the passenger or by estimating the movement of the head or eye of the passenger;

a display means configured to display an image;

a displayed image displacement computing means configured to compute a translational displacement of an image displayed by the display means using information that indicates a movement of the vehicle detected by the vehicle motion detecting means;

a relative displacement computing means configured to compute the relative displacement between said displayed image and the head or eye of the passenger based on information indicating the translational displacement computed by the displayed image displacement computing means and the motion value related to a movement of the head or an eye of the passenger determined by the motion value determining means; and

a display control means configured to make the display means display images in such a manner as to cancel said translational displacement and said relative displacement.

[Claim 3]

The vehicle-installed display device as recited in claim 2, wherein

the motion value determining means determines the motion value using a response function expressing the vibration of a human body in response to the undulations of a

vehicle or using a numerical model.

[Claim 4]

The vehicle-installed display device recited in claim 3, wherein

the motion value determining means determines the motion value using the physique and sitting posture of the passenger as estimated parameters.

[Claim 5]

The vehicle-installed display device recited in claim 3, wherein

the motion value determining means estimates the sitting posture and physique of the passenger based on the distribution of body pressure on the seat on which the passenger is sitting and selects a response function expressing said human body vibration or a numerical model based on the estimated sitting posture and physique.

[Claim 6]

A portable display device, comprising

a display means configured to display an image;

a motion detecting means configured to detect movements of the display ;

a displayed image displacement computing means configured to compute a translational

displacement of an image displayed by the display means using information that indicates a movement of the display means detected by the motion detecting means; and

a display control means configured to make the display means display images in such a manner as to cancel the translational displacement computed by the displayed image displacement computing means.

[*Detailed Description of the Invention*]

[0001]

[TECHNICAL FIELD TO WHICH THE INVENTION BELONGS]

The present invention relates to a vehicle-installed display device that displays images inside a vehicle and to a portable-type display device.

[0002]

[PRIOR ART]

Regarding display devices that display images, there are known technologies for preventing a viewer from experience a feeling that something is abnormal when the viewer moves. Patent Document 1 discloses a display device that has a Fresnel lens or other optical element arranged between the display device and the viewer. The Fresnel lens causes the viewer to see a virtual image projected to a position close to infinity. When the viewer views from below a normal line of the Fresnel lens, the projected image is seen above the normal line and when the viewer views from above a normal line, the projected image is seen below the normal line.

[0003]

Patent Document 2 discloses a display device that is fixed to the head of the viewer. This

display device causes the image to appear stationary to the viewer by scrolling the displayed image oppositely to the movement of the viewer's head when the viewer's head moves.

[0004]

[Patent Document 1]

Japanese Laid-Open Patent Publication No. 10-73785

[Patent Document 2]

Japanese Laid-Open Patent Publication No. 8-220470

[0005]

[OBJECTS THE INVENTION IS TO ACHIEVE]

With the technology of Patent Document 1, it is difficult to reduce the size of the display in a case, for example, where the display is installed inside a vehicle because an optical element is disposed between the viewer and the display and it is necessary to secure space for the optical path of the optical element. Meanwhile, the technology of Patent Document 2 is not well-suited to situations in which an image is viewed on a display device that is installed inside a vehicle or a display device that is held in the hand of the viewer because said technology requires the display device to be fastened to the viewer's head.

[0006]

The object of the present invention is to provide a vehicle-installed display device and portable display device that do not cause the viewer to experience a feeling that something is abnormal when the relative positions of the display device and the viewer fluctuate.

[0007]

[MEANS OF ACHIEVING THE OBJECT]

A vehicle-installed display device in accordance with the present invention detects movements of the vehicle, computes the translational displacement of the displayed image based on the detected information, and displays the image in such a manner as to cancel the displacement.

A vehicle-installed display device in accordance with the present invention determines a motion value related to the head (eye) of a passenger by either actually detecting or estimating a movement of the head (eye) of the passenger, computes the translational displacement of a displayed image based on the detected vehicle movement, and – based on information indicating the translational displacement and the motion value related to the head (eye) of the passenger – displays the image in such a manner as to cancel the displacement of the displayed image and the relative displacement between the head (eye) of the passenger and the displayed image.

A portable display device in accordance with the present invention detects movements of the display means, computes the translational displacement of the displayed image based on the detected information, and displays the image in such a manner as to cancel the displacement.

[0008]

[EFFECTS OF THE INVENTION]

The present invention computes the translational displacement of an image displayed by a display means, computes the relative displacement between the head of a viewer (passenger) and a and the displayed image, and makes the display means display the

image in such a manner as to cancel the computed displacement (relative displacement). Thus, the present invention makes it possible to prevent a passenger viewing a displayed image from experiencing a feeling that something is abnormal when the relative positions of the display means and the head of the viewer fluctuate.

[0009]

[EMBODIMENTS OF THE INVENTION]

Embodiments of the present invention will now be described with reference to the drawings.

(First Embodiment)

Figure 1 is a block diagram outlining a vehicle-installed display device in accordance with a first embodiment of the present invention. In Figure 1, the vehicle-installed display device 100 has a vehicle motion detecting section 101, a passenger motion estimating section 104, a seat surface pressure detecting section 102, a human body database section 103, a control section 106, an image input section 105, an image displacement section 107, and an image display section 108. The viewer sits on a seat (not shown in the figures) inside a vehicle and views an image displayed on the image display section 108.

[0010]

The vehicle motion detection section 101 detects both the translational motion and the rotational motion of the vehicle and sends detection signals to the passenger motion estimating section 104 and the control section 106. The seat surface pressure detecting section 102 detects the distribution of body pressure on the seat on which the viewer (in this case, a passenger of the vehicle) is sitting and sends a detection signal to the

passenger motion estimating section 104. The human body database section 103 stores data indicating the relationship between the body pressure distribution and the physique of the passenger, data indicating the relationship between the body pressure distribution and the sitting posture of the passenger, and data indicating vibration transmission functions for various parts of the human body (particularly the head) in relation to vehicle undulations. The stored data is obtained in advance from measurements related to a plurality test subjects having different physiques and stored in a database form. The vehicle undulations are indicated by the vehicle motion detection values.

[0011]

Using the detection values indicating the vehicle motion and the detection value indicating the body pressure distribution, the passenger motion estimating section 104 reads information indicating the head motion of a person having a physique and posture similar to those of the passenger from the human body database section 103 and estimates the motion (displacement) of the passenger's head section, particular the eyes. The passenger motion estimating section 104 then sends information indicating the estimated displacement of the passenger's eyes to the control section 106.

[0012]

The image input section 105 receives display data from an external device and sends the display data to the image displacement section 107. The display data is data for an image or text to be displayed on the image display section 108. The control section 106 determines the amount of displacement of the image using the information indicating the estimated displacement of the passenger's eyes and the detection signal indicating the vehicle motion. In addition to determining the amount of image displacement, the control section 106 is configured to control the other sections of the vehicle-installed display

device 100. The control section 106 sends information indicating the amount of image displacement determined by the control section 106 to the image displacement section 107. Based on the information indicating the amount of image displacement, the image displacement section 107 modifies the display data in such a manner that the position of the image (including text) moves (shifts) within the display screen of the image display section 108. Image shifting is discussed in more detail later.

[0013]

After modification, the display data is sent to the image display section 108 as a display signal adapted to the input interface of the image display section 108. The image display section 108 is, for example, a liquid crystal display device and displays images (including text) in accordance with the inputted display signal.

[0014]

The present invention serves to make the image displayed on the image display section 108 appear stationary in space to the passenger, even when the vehicle is accelerating or decelerating. In the first embodiment, the relative displacement between the head (particularly the eyes) of the passenger and the image display section 108 is calculated and the image (including text) on the display screen of the image display section 108 is moved in accordance with the relative displacement. The motion of the passenger's head is estimated using the body pressure distribution detected when the passenger sits.

[0015]

The flow of the display processing executed by the control section 106 of the vehicle display device 100 will now be described with reference to the flowchart of Figure 2. In step S10, the control section 106 determines if the power to the screen of the image display section 108 is ON. If the screen power is ON, the control section 106 obtains an

affirmative result for step S10 and proceeds to step S20. If the screen power is not ON, the control section obtains a negative result for step S10 and repeats step S10.

[0016]

In step S20, the control section 106 issues a command to the seat surface pressure detecting section 102 instructing the same to detect the distribution of body pressure on the seat on which the passenger is sitting (body pressure measurement) and then proceeds to step S30. In step S30, the control section 106 issues a command to the passenger motion estimating section 104 instructing the same to estimate the physique and posture of the passenger and then proceeds to step S40. In response to this command, the passenger motion estimating section 104 searches the human body database and selects the physique and posture corresponding to the body pressure distribution that is closest to the detected body pressure distribution as the estimate values for the physique and posture of the passenger.

[0017]

In step S40, the control section 106 issues a command to the vehicle motion detecting section 101 instructing the same to detect the motion of the vehicle (motion measurement) and then proceeds to step S50. In responds to the command, the vehicle motion detecting section 101 detects the translational motion and rotational motion of the vehicle. In step S50, the control section 106 determines if the passenger's posture has changed. The control section 106 compares the previous posture estimate value to the current posture estimate value and proceeds to step S60 (obtains affirmative result for step S50) if the two estimate values are different and proceeds to step S70 (obtains negative result for step S50) if the two estimate values are the same.

[0018]

In step S60, the control section 106 issues a command to the passenger motion estimating section 104 instructing the same to select a human body vibration transmission function and then proceeds to step S70. In response to the command, the passenger motion estimating section 104 searches the human body database and selects a human body vibration transmission function corresponding to the currently estimated physique and posture of the passenger and the latest detection values for the vehicle motion.

[0019]

In step S70, the control section 106 issues a command to the passenger motion estimating section 104 instructing the same to estimate the motion of the passenger's head and then proceeds to step S80. In response to the command, the passenger motion estimating section 104 calculates an estimate value for the motion of the passenger's head (particularly the eyes) using the human body vibration transmission function and the vehicle motion detection values. In step S80, the control section 106 uses the detection signal indicating the vehicle motion to calculate the amount of translational screen movement associated with rotational motion of the vehicle and then proceeds to step S90. The screen movement calculated here is the amount by which the image display section 108 moves in the pitch direction (up or down).

[0020]

In step S90, the control section 106 calculates the relative displacement between the eyes of the passenger and the image display section 108 and then proceeds to step S100. In step S100, the control section 106 uses the vertical movement amount of the screen and the aforementioned relative displacement to calculate the amount by which the image displayed by the image display section 108 needs to be displaced in order to appear stationary in space (without undulations) to the passenger. Then the control section

proceeds to step S110.

[0021]

In step S110, the control section 106 sends information indicating the calculated amount of image displacement to the image displacement section 107 and issues a command instructing the same to shift the image. In response to this command, the image displacement section 107 modifies the display data received through the image input section 105 in accordance with said displacement amount. Meanwhile, the control section 106 proceeds to step S120.

[0022]

In step S120, the control section 106 issues a command to the image display section 108 instructing the same to display the image described by the modified display data and then proceeds to step S130. As a result, an image that has been moved within the screen is displayed on the image display section 108. In step S130, the control section 106 determines if the power to the screen of the image display section 108 has been turned OFF. If the screen power has been turned OFF, the control section obtains an affirmative result for step S130 and ends the processing of Figure 2. Meanwhile, if the screen power has not been turned OFF, the control section 106 obtains a negative result for step S130 and returns to step S20 to repeat the processing.

[0023]

The details of the image shifting will now be described. Focusing on motion in the pitch direction accompanying acceleration or deceleration of the vehicle, the displacement of relative positions of the passenger's eyes and the image display section 108 can be roughly divided into the following two types:

(1) Displacement caused by pitch motion of the vehicle

(2) Displacement caused by pitch motion of the passenger (particularly the eyes)

[0024]

The displacement type (1) will now be described with reference to Figure 3 (a). Generally, when a vehicle decelerates, a nosedive phenomenon occurs in which the front section of the vehicle dips downward. If the display screen of the image display section 108 is located in the direction of vehicle movement with respect to the passenger, the nosedive will cause the image display section 108 to undergo rotational motion in the pitch direction (downward). Consequently, assuming the position of the passenger's head (particularly the eyes) does not move, the image display device 108 will appear (to the passenger) to move downward. Therefore, the control section 106 modifies the display data in order to displace the display position of the image in the pitch direction (upward), thus canceling out the movement of the image display section 108.

[0025]

Figure 3 (b) illustrates the image shift executed in order to cancel the pitch motion of the vehicle when the vehicle nosedives. As shown in Figure 3 (b), the image displayed on the image display section 108 is moved upward in accordance with the amount by which the image display section 108 moves downward. As a result, the relative displacement between the displayed image and the eyes of the passenger is zero and the displayed image appears stationary in space to the passenger.

[0026]

Conversely to when the vehicle decelerates, when the vehicle accelerates a squatting phenomenon occurs in which the rear section of the vehicle dips downward. If the display screen of the image display section 108 is located in the direction of vehicle

movement with respect to the passenger, the squatting will cause the image display section 108 to undergo rotational motion in the pitch direction (upward). Consequently, assuming the position of the passenger's head (particularly the eyes) does not move, the image display device 108 will appear (to the passenger) to move upward. Therefore, the control section 106 modifies the display data in order to displace the display position of the image in the pitch direction (downward), thus canceling out the movement of the image display section 108.

[0027]

Figure 3 (c) illustrates the image shift executed in order to cancel the pitch motion of the vehicle when the vehicle squats. As shown in Figure 3 (c), the image displayed on the image display section 108 is moved upward in accordance with the amount by which the image display section 108 moves downward. As a result, the relative displacement between the displayed image and the eyes of the passenger is zero and the displayed image appears stationary in space to the passenger.

[0028]

The displacement type (2) will now be described with reference to Figure 4 (a). When the vehicle actually decelerates or accelerates, the passenger's head also undergoes rotational motion in the pitch direction. As shown in Figure 4 (a), the passenger's head rotates forward when the vehicle decelerates and, assuming the position of the image display section 108 does not move, the position of the passenger's head (particularly the eyes) moves downward with respect to the image display section 108. Therefore, in order to display the image such that it appears stationary in space to the passenger, the image displayed on the image display section 108 is moved downward in accordance with the amount of downward movement of the passenger's eyes, as shown in Figure 4 (b). Thus,

the direction of the image shift is the same as in Figure 3 (c), i.e., the same as when canceling the vehicle pitch motion associated with squatting.

[0029]

Conversely to when the vehicle decelerates, the passenger's head rotates rearward when the vehicle accelerates and, assuming the position of the image display section 108 does not move, the position of the passenger's head (particularly the eyes) moves upward with respect to the image display section 108. Therefore, in order to display the image such that it appears stationary in space to the passenger, the image displayed on the image display section 108 is moved upward in accordance with the amount of upward movement of the passenger's eyes. Thus, the direction of the image shift is the same as in Figure 3 (b), i.e., the same as when canceling the vehicle pitch motion associated with nose-diving.

[0030]

In the first embodiment, the relative displacement between the image display section 108 and the eyes of the passenger is found and image shifting is performed in accordance with the relative displacement. As a result, the image is shifted in such a manner as to cancel the influences of both types of pitch motion, i.e., (1) and (2).

[0031]

The following operational effects are obtained with the first embodiment described heretofore.

(1) The physique and sitting posture of the passenger is estimated by measuring the pressure exerted by the body of the passenger when seated and searching a human body database 103. As a result, an appropriate human body vibration transmission function can be selected regardless of whether the passenger is an adult or a child or a man or a woman.

[0032]

(2) Since the human body vibration transmission function mentioned in (1) above and detection data indicating the vehicle motion are used to calculate an estimate value for the motion of the passenger's head (particularly the eyes), the position of the passenger's eyes can be obtained without providing motion detection sensors on the passenger's head. Since sensors are not attached to the passenger, the cost is held in check and a burden is not placed on the passenger.

[0033]

(3) Since the amount by which the image display section 108 moves in the pitch direction (up or down) due to rotational motion of the vehicle is calculated using detection data that indicates the vehicle motion, the position of the image display section 108 can be obtained without providing a motion detection sensor for the image display section 108.

[0034]

(4) Since the relative displacement between the eyes of the passenger and the image display section 108 is found using the eye position mentioned in (2) above and the position of the image display section mentioned in (3) above, said relative displacement can be obtained even if the two are undergoing different motions.

[0035]

(5) The displayed image appears stationary in space to the passenger because the display position of the image (including text) displayed on the image display section 108 is moved (shifted) in the pitch direction in such a manner as to cancel the movement of the displayed image resulting from movement in the pitch direction (up or down) of the image display section 108 and changes in the relative displacement mentioned in (4) above. As a result, the image is easier for the passenger to view. Furthermore, since the

visual information the passenger obtains when watching the display screen matches the information from the vestibular organs (semicircular canals and otolith organs), the feeling that something is abnormal is reduced in comparison with a case in which the image is not shifted.

[0036]

Additionally, when there is plenty of distance between the image display means 8 and the passenger, the processing of step S70 can be skipped because the motion (displacement) of the passenger's eyes due to rotation of the passenger's head is small. In such a case, it is sufficient to find the relative displacement between the passenger's eyes and the image display section 108 under the assumption that position of the passenger's eyes is fixed.

[0037]

The human body database section 103 of the first embodiment is configured to store data that indicates transmission functions that serve as information regarding how the various body parts (particularly the head) vibrate in response to vehicle undulations. It is also acceptable to store a numerical model in table form. More specifically, a LUT (look up table) can be constructed such that when a value indicating the undulations of the vehicle is inputted to the LUT, a value indicating the vibrations of the human body in response to those undulations is outputted from the LUT.

[0038]

Although the preceding explanation used rotational motion in the pitch direction as an example, similar processing can be performed with respect to rotational motion in the rolling direction (left and right) of the vehicle.

[0039]

(Second Embodiment)

Figure 5 is a block diagram outlining a vehicle-installed display device in accordance with a second embodiment of the present invention. In Figure 5, the vehicle-installed display device 200 has a vehicle motion detecting section 201, a head motion estimating section 202, a screen vibration detecting section 203, a control section 205, an image input section 204, an image displacement section 206, and an image display section 207. The viewer views an image displayed on the image display section 207 inside a vehicle.

[0040]

The vehicle motion detecting section 201 detects both the translational motion and the rotational motion of the vehicle and sends a detection signal to the control section 205. The head motion detecting section 202 comprises, for example, an acceleration sensor built into a headphone and functions to detect both the translational motion and the rotational motion of the viewer's head (here, the head of a passenger in a vehicle) and send the resulting detection signal to the control section 205.

[0041]

The screen vibration detecting section 203 detects the translational motion of the image display section 207 and the rotational motion of the image display section 207 and sends the resulting detection signal to the control section 205. The image input section 204 receives display data from an external device and sends the display data to the image displacement section 206. The control section 205 determines the amount of displacement of the image the detection signal indicating the vehicle motion, the detection signal indicating the head motion, and the detection signal indicating the motion of the image display section 207. In addition to determining the amount of image displacement, the control section 205 is configured to control the other sections of the vehicle-installed display device 200. The control section 205 sends information

indicating the amount of image displacement determined by the control section 205 to the image displacement section 206. Based on the information indicating the amount of image displacement, the image displacement section 107 modifies the display data in such a manner that the position of the image moves (shifts) within the display screen of the image display section 207. The image shifting is the same as in the first embodiment.

[0042]

After modification, the display data is sent to the image display section 207 as a display signal. The image display section 207 is, for example, a liquid crystal display device and displays images in accordance with the inputted display signal.

[0043]

In the second embodiment, the motion of the passenger's head (particularly the eyes) is detected directly by the head motion detecting section 202 and the motion of the image display section 207 is detected directly by the screen vibration detecting section 203.

[0044]

The flow of the display processing executed by the control section 205 of the vehicle display device 200 will now be described with reference to the flowchart of Figure 6. In step S210, the control section 205 determines if the power to the screen of the image display section 207 is ON. If the screen power is ON, the control section 205 obtains an affirmative result for step S210 and proceeds to step S220. If the screen power is not ON, the control section obtains a negative result for step S210 and repeats step S210.

[0045]

In step S220, the control section 205 issues a command to the vehicle motion detecting section 201 instructing the same to detect the motion of the vehicle (motion measurement) and then proceeds to step S230. In response to the command, the vehicle

motion detecting section 201 detects the translational motion and rotational motion of the vehicle. In step S230, the control section 205 issues a command to the screen vibration detecting section 203 instructing the same to detect the motion of the image display section 207 and then proceeds to step S240. In response to the command, the screen vibration detecting section 203 detects the translational motion and rotational motion of the image display section 207.

[0046]

In step S240, the control section 205 issues a command to the head motion detecting section 202 instructing the same to detect the motion of the passenger's head and then proceeds to step S250. In response to the command, the head motion detecting section 202 detects the translational motion and rotational motion of the passenger's head (particularly the eyes). In step S250, the control section 205 uses the detection signal indicating the vehicle motion to calculate the amount of translational motion of the screen resulting from rotational motion of the vehicle and then proceeds to step S260. This screen movement amount is the amount of movement of the image display section 207 in both the pitch direction (up and down) and the roll direction (left and right).

[0047]

In step S260, the control section 205 calculates the relative displacement between the vehicle and the eyes of the passenger using the aforementioned detection values and the proceeds to step S270. In step S270, the control section 205 calculates the relative displacement between the vehicle and the image display section 207 using the aforementioned detection values and proceeds to step S280. In step S280, the control section 205 uses the screen movement amount and the relative displacements just mentioned to calculate the displayed image displacement amount required to make the

image displayed by the image display section 207 appear stationary in space (without undulations) to the passenger. A separate image displacement amount is calculated for each of the up-and-down direction and the left-and-right direction. The controller proceeds to step S290.

[0048]

In step S290, the control section 205 sends information indicating the calculated displacement amounts to the image displacement section 206 and issues a command instructing the same to shift the image. In response to the command, the image displacement section 206 modifies the display data received from the image input section 204 in accordance with the displacement amounts. The control section proceeds to step S300.

[0049]

In step S300, the control section 205 issues a command to the image display section 207 instructing the same to display the image described by the modified display data and then proceeds to step S310. In response to the command, the image display section 207 displays an image that has been moved within the screen. In step S310, the control section 205 determines if the power to the screen of the image display section 207 is OFF. If the screen power is OFF, the control section 205 obtains an affirmative result for step S310 and ends the processing of Figure 6. Meanwhile, if the screen power is not OFF, the control section 205 obtains a negative result for step S310 and returns to step S320 [*sic*] to repeat the processing.

[0050]

The following operational effects are obtained with the second embodiment described heretofore.

(1) Since the head motion detecting section 202 detects the motion of the passenger's head (particularly the eyes) directly, the position of the passenger's eyes can be obtained accurately irregardless of the passenger's physique and posture or whether the passenger is an adult or a child.

[0051]

(2) Since the screen vibration detecting section 203 detects the motion of the image display section 207 directly, the position of the image display section 207 can be obtained accurately in situations where the motion of the image display section 207 is different from the motion of the vehicle, such as when the image display section 207 is installed on a backrest and its position fluctuates due to the vibrations of the backrest.

[0052]

(3) The displayed image appears stationary in space to the passenger because the display position of the image (including text) displayed on the image display section 207 is moved in consideration of the relative displacement between the eyes of the passenger and the image display section 207 using the eye position mentioned in (1) above and the position of the image display section mentioned in (2) above. As a result, similarly to the first embodiment, the image is easier for the passenger to view and the feeling on the part of the passenger that something is abnormal can be reduced.

[0053]

Although the preceding explanation described a head motion detecting section having a built-in acceleration sensor, it is also acceptable to use a built-in gyro sensor or a magnetic position sensor instead. Any of these sensors, i.e., an acceleration sensor, a gyro sensor, or a magnetic position sensor, can also be used in the vehicle motion detecting section 201 and the screen vibration detection section 203.

[0054]

It is also acceptable to photograph the passenger using a vehicle-installed camera and analyze the photographic image to obtain the motion (displacement) of the passenger's eyes.

[0055]

Regarding the vehicle-installed display device 200 in Figure 5, it is also acceptable for the image display section 207 to be held in the hand of the passenger instead of mounted to a backrest.

[0056]

(Third Embodiment)

The display device can be a portable game, a portable information terminal (PDA), a portable telephone, or the like. Figure 7 is a block diagram outlining a portable display device in accordance with a third embodiment of the present invention. In Figure 7, the portable display device 300 has a screen undulation detecting section 301, an image input section 302, a control section 303, an image displacement section 304, and an image display section 305. The viewer holes the portable display device 300 and views an image displayed on the image display section 305.

[0057]

The screen undulation detecting section 301 detects movement of the image display section 305 at frequencies of several hertz resulting from shaking of the viewer's arm while the viewer holds the portable display device 300. The control section 303 uses the information detected by the screen undulation detecting section 301 to calculate the amount of displacement of the image display section 305. It then sends information indicating the calculated displacement amount to the image displacement section 304 and

issues a command signal instructing the same to shift the image. The image displacement section 304 shifts the image in such a manner as to cancel the displacement indicated by said information.

[0058]

The following operational effects are obtained with the third embodiment described heretofore.

(1) Similarly to the first and second embodiments, the game image, electronic book, or text information displayed on the image display section 305 becomes easier for the viewer to view because the image displayed on the image display section 305 is shifted.

[0059]

(2) The portable display device 300 can be made more compact than the second embodiment because the vehicle motion detecting section 201 and the head motion detection section 202 are eliminated.

[0060]

The portable display device 300 can also be provided with a head motion detecting section like that of the second embodiment. In such a case, since the motion of the viewer's head (particularly the eyes) can be detected with the head motion detecting section, the display position of the image (including text) displayed on the image display section 305 can be moved in consideration of the relative displacement between the viewer's head and the image display section 305 by using the detected positions of the viewer's head and the image display section. As a result, the viewability of the displayed content can improved even further.

[0061]

The correspondence between the constituent elements of the claims and the constituent

elements of the embodiments will now be explained. The vehicle motion detecting means is constituted by, for example, the vehicle motion detection section 101 (201). The display means is constituted by, for example, the image display section 108 (207, 305). The translational displacement corresponds, for example, to the image movement amount. The displayed image displacement computing means and relative displacement computing means are constituted by, for example, the control section 106 (205, 303). The display control means is constituted by, for example, the image displacement section 107 (206, 304). The motion value determining means is constituted by, for example, the head motion detecting section 202 or a passenger motion estimating section 104. The response function corresponds to, for example, the transmission function. The motion detecting means is constituted by, for example, an image vibration detecting section 203 (image undulation detecting section 301). Moreover, so long as the characteristic functions of the invention are not lost, the constituent elements of the present invention are not limited to those described heretofore.

[BRIEF DESCRIPTIONS OF THE DRAWINGS]

Figure 1 is a block diagram outlining a vehicle-installed display device in accordance with a first embodiment of the present invention.

Figure 2 is a flowchart illustrating the flow of the display processing executed by the control section.

Figure 3 (a) illustrates displacement of the screen position due to pitch motion of the vehicle; (b) illustrates the image shift executed in order to cancel the pitch motion of the vehicle when the vehicle nosedives; (c) illustrates the image shift executed in order to

cancel the pitch motion of the vehicle when the vehicle squats.

Figure 4 (a) illustrates displacement of the screen position due to pitch motion of the passenger's head; (b) illustrates the image shift executed in order to cancel the pitch motion of the passenger's head (particularly the eyes) when the passenger's head pitches forward.

Figure 5 is a block diagram outlining a vehicle-installed display device in accordance with a second embodiment of the present invention.

Figure 6 is a flowchart illustrating the flow of the display processing executed by the control section.

Figure 7 is a block diagram outlining a vehicle-installed display device in accordance with a third embodiment of the present invention.

[DESCRIPTIONS OF THE REFERENCE SYMBOLS]

100 (200) vehicle-installed display device

101 (201) vehicle motion detecting section

102 seat surface pressure detecting section 103 human body database section

104 passenger motion estimating section

105 (204, 302) image input section

106 (205, 303) control section

107 (206, 304) image displacement section

108 (207, 305) image display section

202 head motion detecting section 203 screen vibration detecting section

300 portable display device 301 screen undulation detecting section

Figure 1

101 vehicle motion detecting section

102 seat surface pressure detecting section

103 human body database section

104 passenger motion estimating section

105 image input section

106 control section

107 image displacement section

108 image display section

Figure 2

S10 Is screen power ON?

S20 Measure body pressure.

S30 Estimate physique and posture.

S40 Measure vehicle motion.

S50 Has posture changed?

S60 Select human body vibration transmission function.

S70 Estimate head motion.

S80 Calculate screen movement amount resulting from vehicle rotation.

S90 Calculate relative displacement between screen and eyes.

S100 Calculate image displacement amount

S110 Shift image.

S120 Display image.

S130 Is screen power OFF?

Figure 3

(a)

* Screen moves downward due to nosedive of vehicle.

Screen

Relative displacement between ground surface and vehicle (screen displacement due to pitch motion of vehicle)

* The image is shifted upward when the vehicle nosedives and downward when the vehicle squats.

Screen

(b) Nosedive (c) Squat

Figure 4

Height of eyes changes   Screen   Screen

* The image is shifted downward when the passenger's head rotates forward and upward when the passenger's head rotates rearward.

Relative displacement between vehicle and passenger (change in eye height due to pitch motion of head)

Figure 5

201 vehicle motion detecting section

202 head motion detecting section

203 screen vibration detecting section

204 image input section

205 control section

206 image displacement section

207 image display section

Figure 6

S210 Is screen power ON?

S220 Measure vehicle motion.

S230 Measure screen vibration.

S240 Measure head motion.

S250 Calculate screen movement amount resulting from vehicle rotation.

S260 Calculate relative displacement between vehicle and eyes.

S270 Calculate relative displacement between vehicle and screen.

S280 Calculate image displacement amount

S290 Shift image.

S300 Display image.

S310 Is screen power OFF?

Figure 7

301 screen undulation detecting section

302 image input section

303 control section

304 image displacement section

305 image display section

[Document Type] Abstract

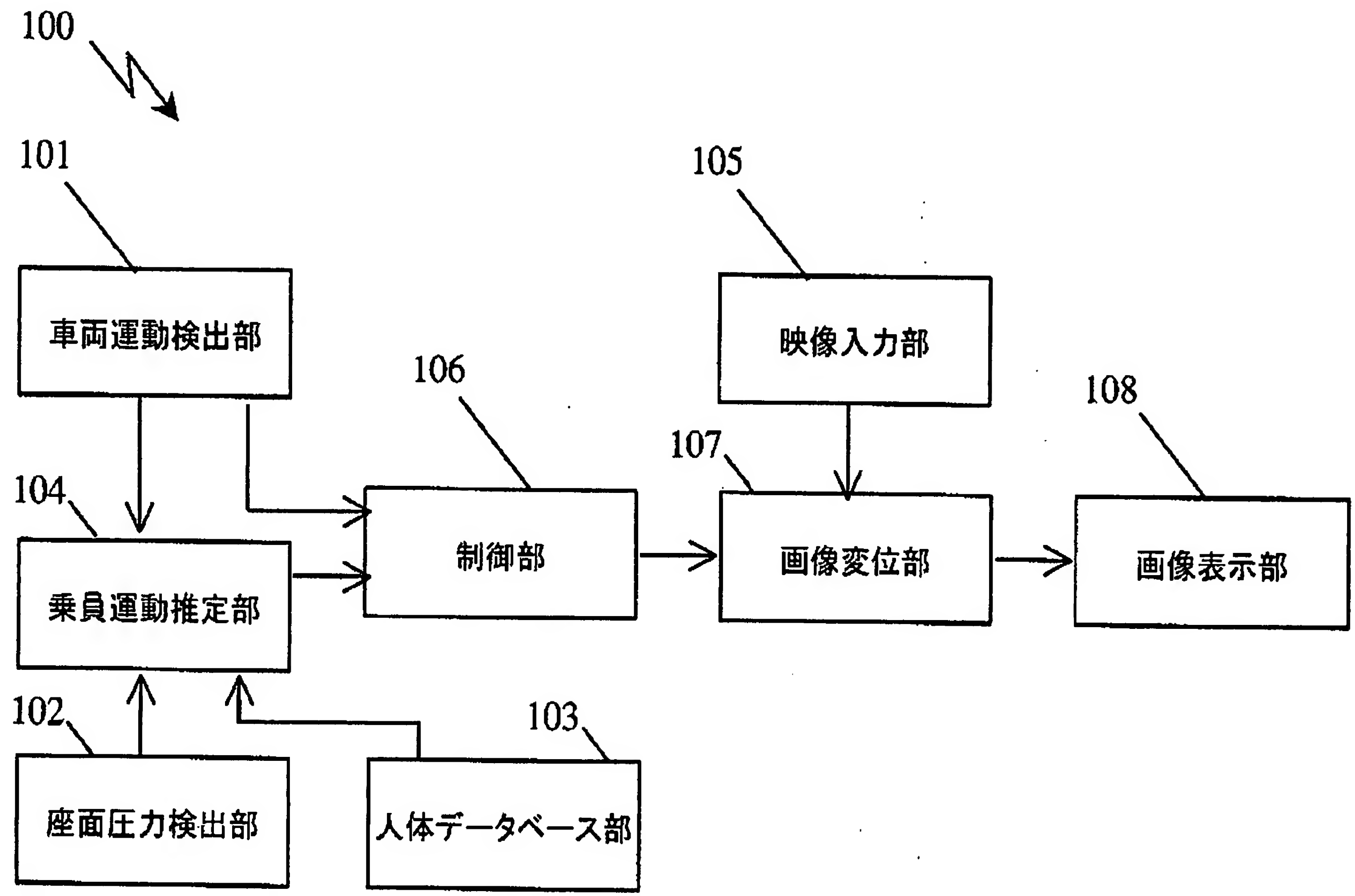
[Abstract]

[OBJECT] To provide a vehicle-installed display device that does not cause the viewer to experience a feeling that something is abnormal, even when the relative positions of the display device and the viewer fluctuate.

[CONSTITUTION] The vehicle-installed display device 100 measures the state of the pressure exerted on a seat by a passenger, estimates the passenger's physique and sitting posture by searching a database 103, and selects human body vibration transmission function. Using the human body vibration transmission function and detection data indicating the motion of the vehicle, the display device calculates an estimate value for the motion of the passenger's head (particularly the eyes). Using the detection data that indicates the motion of the vehicle, the display device calculates the amount of movement of the image display section 108 in the pitch direction. Using the estimated position of the passenger's eyes and the position of the image display section 108, the display device calculates the relative displacement between the passenger's eyes and the image display section. The display device moves the display position of the image displayed on the image display section 108 in such a manner as to cancel the movement of the displayed image that results from the movement of the image display section 108 in the pitch direction and the said relative displacement. As a result, the displayed image appears stationary in space to the passenger.

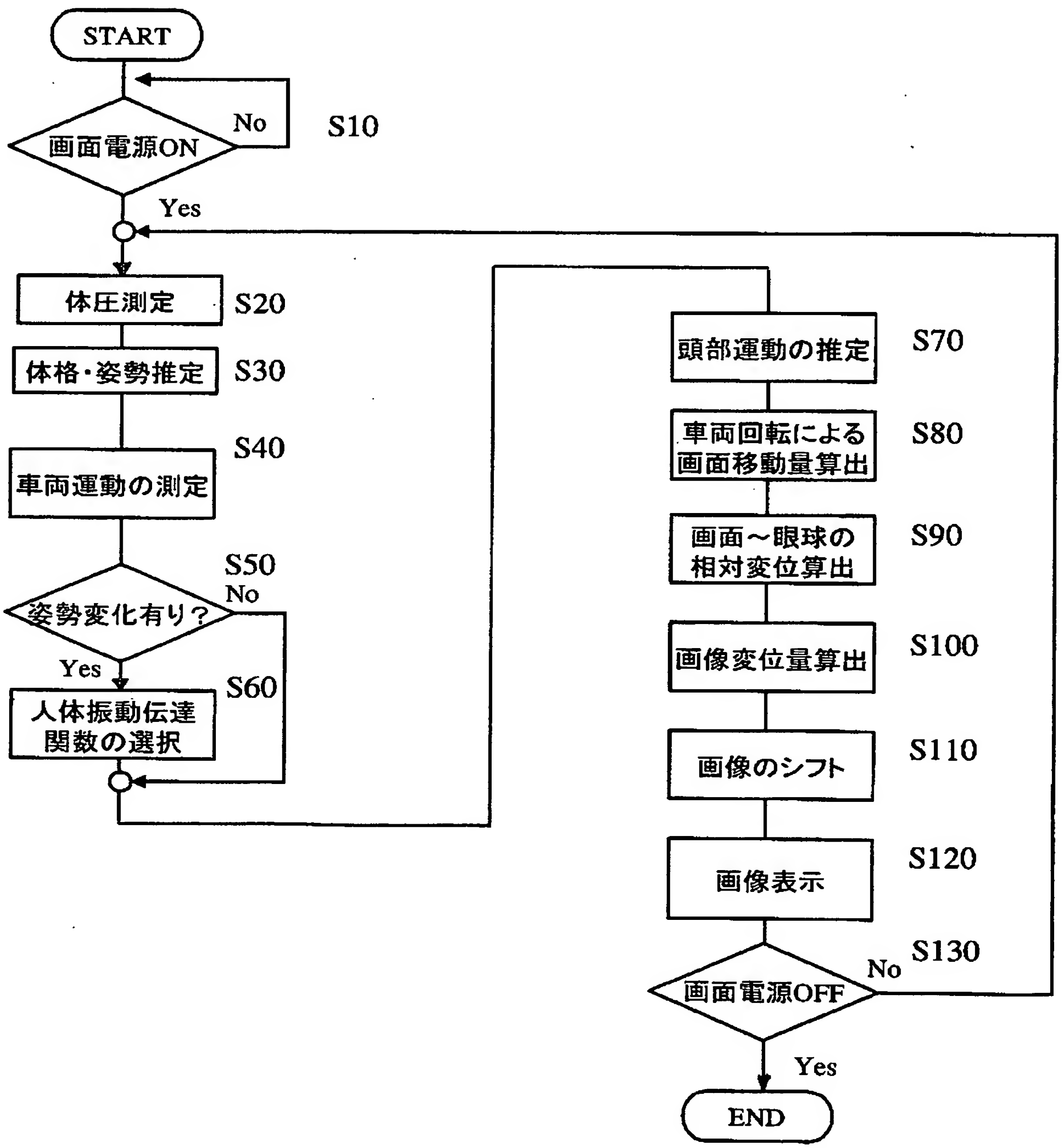
[Selected Drawing] Figure 1

【図1】

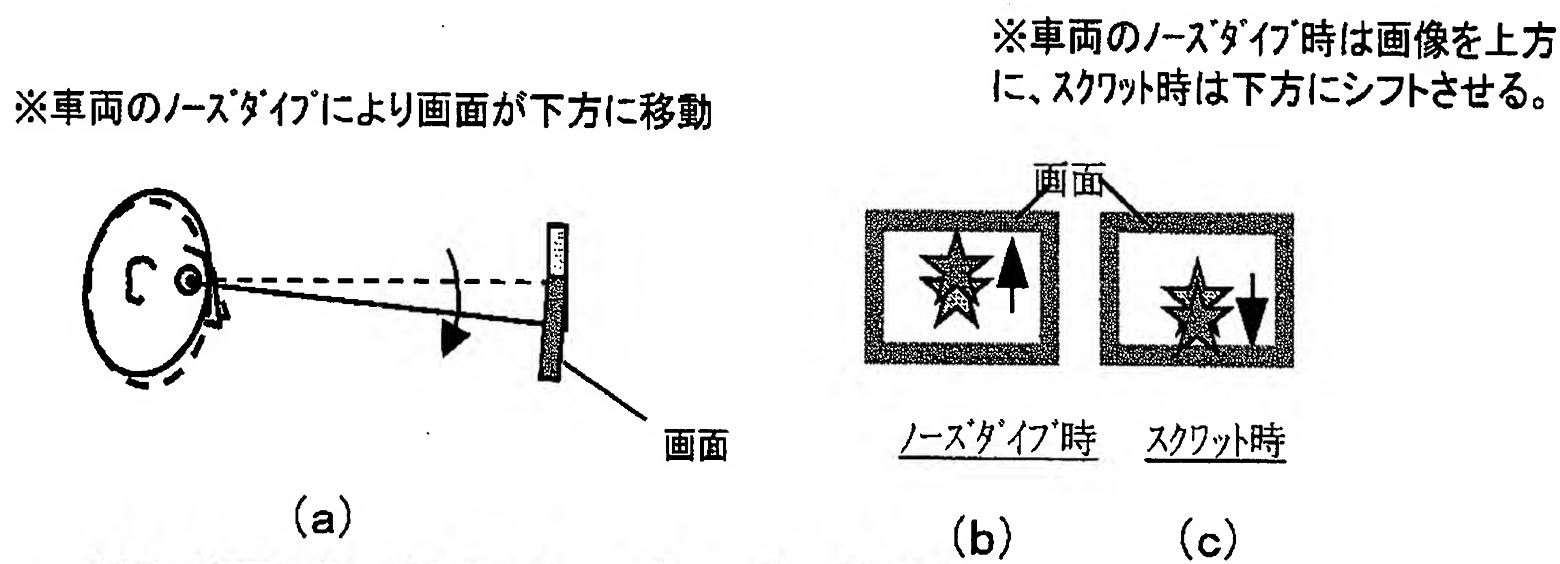


100
101
車両運動検出部
104
乗員運動推定部
102
座面圧力検出部
103
人体データベース部
106
制御部
105
映像入力部
107
画像変位部
108
画像表示部

【図2】

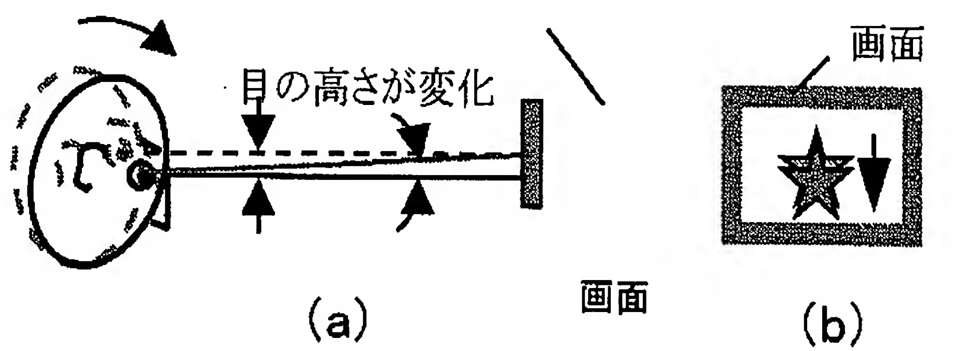

START
画面電源ON
No
S10
Yes
体圧測定
S20
体格・姿勢推定
S30
S40
車両運動の測定
S50
No
姿勢変化有り？
Yes
S60
人体振動伝達
関数の選択
頭部運動の推定
S70
車両回転による
画面移動量算出
S80
画面～眼球の
相対変位算出
S90
画像変位量算出
S100
画像のシフト
S110
画像表示
S120
S130
No
画面電源OFF
Yes
END

【図3】



地面～車両の相対変位（車両ピッチ動による画面変位）

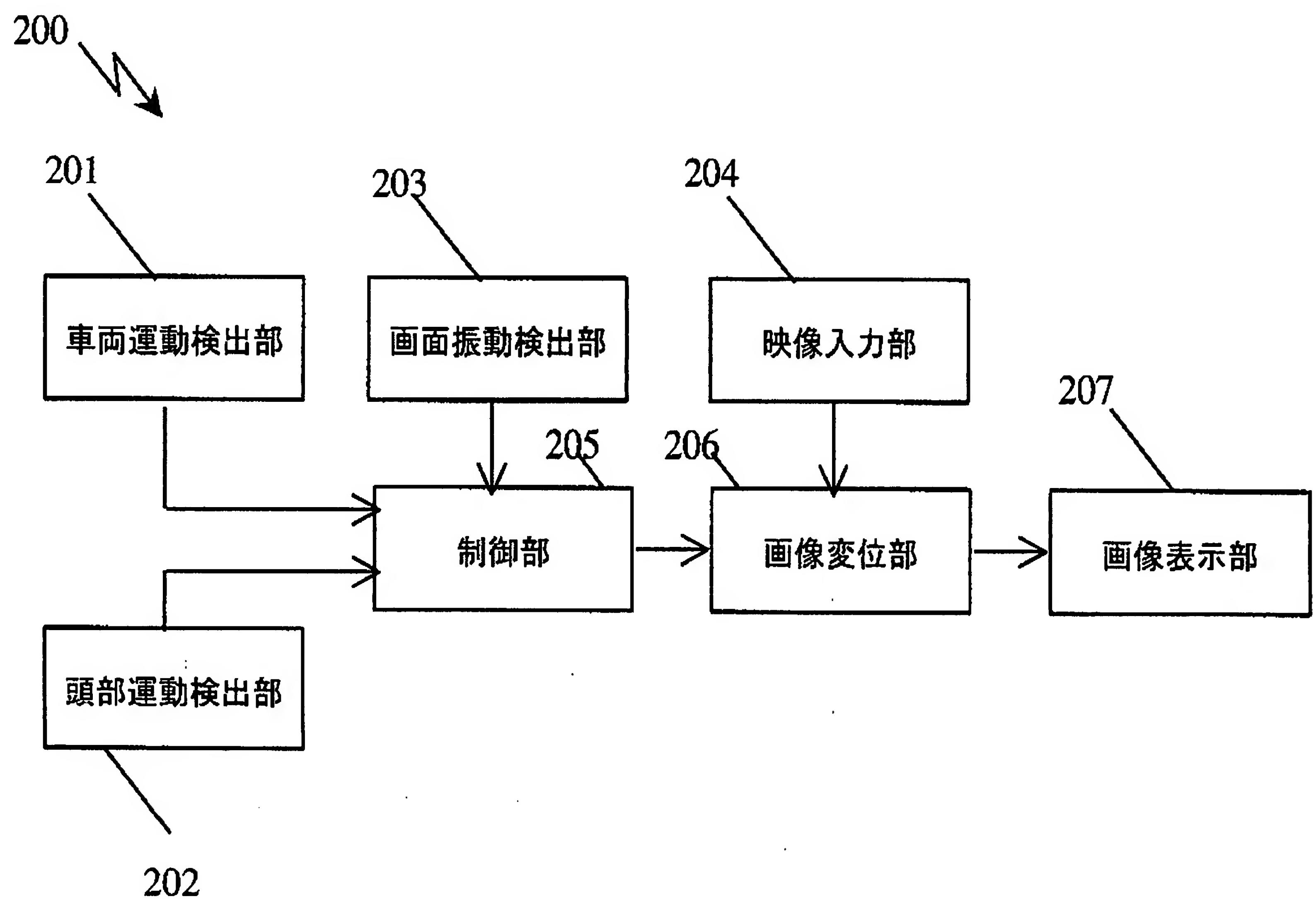
【図4】



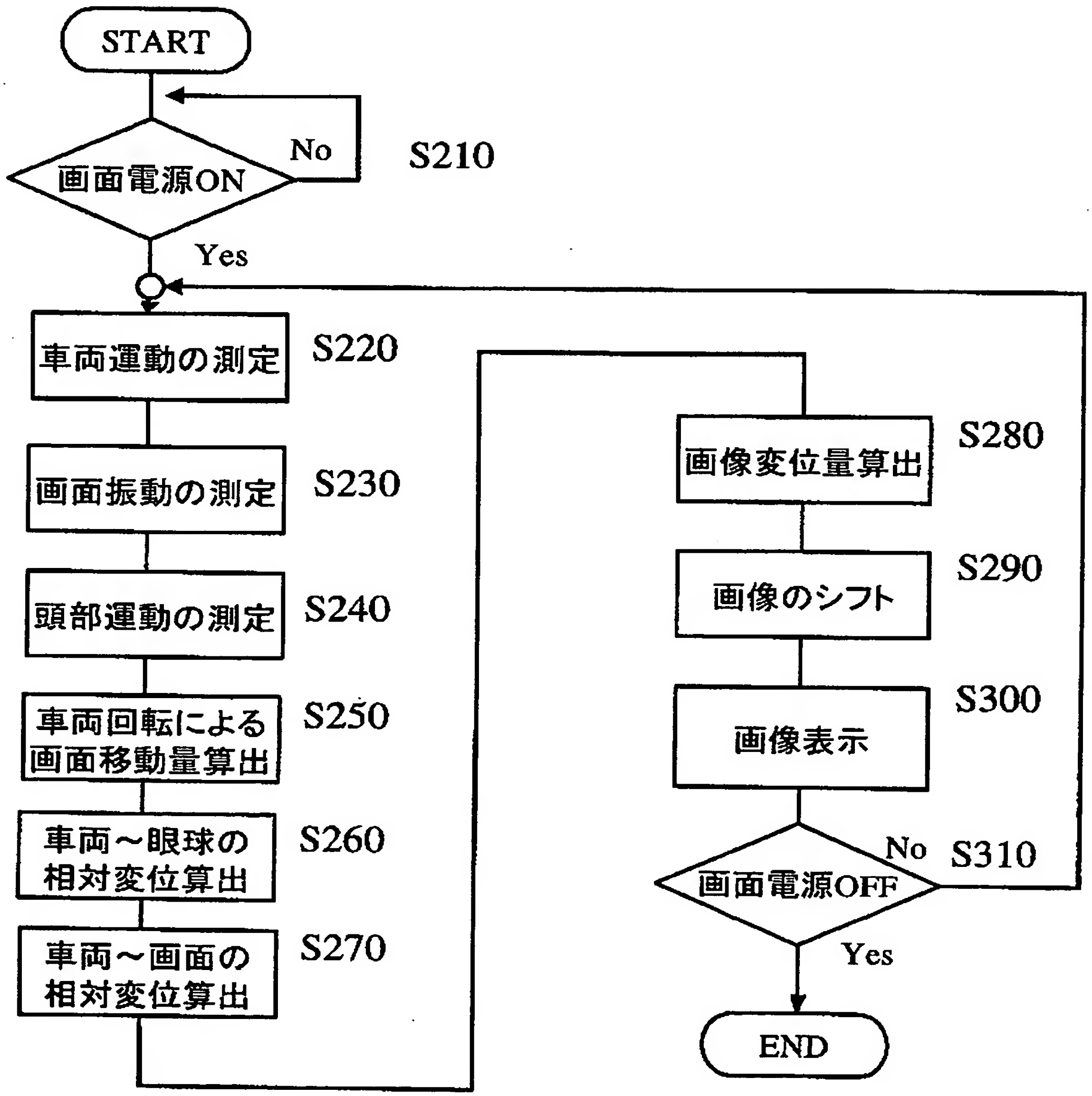
※頭部前方回転時は画像を下方に、後方回転時は画像を上方にシフトさせる。

車両～乗員の相対変位(頭部ピッチ動による目の高さの変化)

【図5】


200
201
車両運動検出部
203
画面振動検出部
204
映像入力部
205
制御部
206
画像変位部
207
画像表示部
頭部運動検出部
202

【図6】


START
画面電源ON
No
S210
Yes
車両運動の測定
S220
画面振動の測定
S230
頭部運動の測定
S240
車両回転による
画面移動量算出
S250
車両～眼球の
相対変位算出
S260
車両～画面の
相対変位算出
S270
画像変位量算出
S280
画像のシフト
S290
画像表示
S300
画面電源OFF
No
S310
Yes
END

【図7】